



Multi-Role Aviation Weapon System (MRAWS) Background & Advanced 30mm Combat Round

Mr. Henry Zandberg & Mr. John Hirlinger

**Light Armament Division
CCAC, TACOM-ARDEC**

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MRAWS Presentations Flow

- **MRAWS Program History**
- **Advanced 30MM Combat Round (A30CR)**
- **Precision Electric Turret (PET)/M230 Gun System**
 - **A30CR Ammunition Fuzing Assumptions**
- **Performance & Benefits Assessment of the Precision Electric Turret**
- **MRAWS Trade Study Conclusions**



- **Original Objective**

- To develop a Precision Electric Turret (PET) and Advanced 30mm Combat Round (A30CR) with potential application to Longbow Apache and other medium caliber turreted platforms

- **Challenging Goals/Exit Criteria**

- 50% increase in antipersonnel performance
 - 30% increase in penetration performance
 - 20% increase in air-to-air capability
 - Turret accuracy improvement from 4.0 to 0.5 mrad
 - Turret weight reduction of 10%
 - Life cycle cost savings of \$6 Mil per year



- Why Needed?
 - Longbow Apache plans call for extended range operations, 1200 round magazine replaced by fuel tanks, stowed load to be significantly reduced
 - Improved gun system performance needed to mitigate planned decrease in stowed load



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MRAWS TECHNOLOGIES/APPLICATIONS



Advanced 30mm Combat Round

Air Burst/Proximity Fuze
Spin Compensated Shape Charge Liner
Steel Case/Compacted Propellant



Composite Structure

Precision Electric Turret



Air to Air



Antipersonnel



Light Armor

Potential Applicability to :
FSCS, FIV, FCS, others



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MRAWS PROJECTED COST SAVINGS

30mm Ammunition

Combat

\$0.75M/yr savings

Imp. performance against:

- Personnel
- Light Armor
- Air Threats



TP Signature Round

\$1.3M/yr savings

Reduced training quantities

Precision Electric Turret

\$4.0M/yr savings

Reliability increase from 50k to 150k MRBF

Accuracy improvement from 4.0 to 0.5 mrad



\$6.0 M Yearly Cost Savings

Due to Increased Reliability and Performance



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Program Redirection

- MRAWS did not achieve STO status
 - Became “bill payer”
- MRAWS listed on User’s Apache Operational Capability Improvement Priority List
 - Priority below funding cut line
- Program limited to trade study
- No follow on efforts
 - Unless User’s priorities change in the future



Trade Study Executed in IPT Mode

- A30CR configuration definition (Government/Boeing)
- A30CR and PET aircraft integration (Boeing/Government)
- A30CR & PET Expected Performance Modeling (All targets) (Boeing/Government)
- Additional performance modeling (Anti-personnel only) (Government/Boeing)



Advanced 30MM Combat Round (A30CR)

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A30CR Design Goals

- Compared To M789
 - 50% Increase in Lethality vs Personnel Targets
 - 30% Increase in Penetration vs RHA
 - 20% Increase in Effectiveness in Air to Air
 - \$0.75M per Year Savings (Based upon Reduced Rounds Required)
 - No Degradation in Effectiveness Vs Light Ground Targets
- Must be Compatible with Basic M230 Weapon
- Minimal Impact to Apache System



Anticipated Percentage of Target Gun Engagements by Typ

	Target Range Band					
	200-500	501-1000	1001-1500	1501-2000	2001-2500	2501-3000
Personnel						
Ground Vehicles						
Helicopters/Aircraft						
Total						

Anticipated Breakdown (percentage) of Gun Targets by Ran

	Target Range Band					
	200-500	501-1000	1001-1500	1501-2000	2001-2500	2501-3000
Personnel						
Ground Vehicles						
Helicopters/Aircraft						

Information Provided by TSM Longbow Office 5/99

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Current Round – M789



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M789 High Explosive Dual Purpose (HEDP)

- M759 PIBD (Spitback Transfer) Fuze
- Copper Spin Compensated (Fluted) Shaped Charge Liner
- PBXN-5 Explosive - Main Charge
- WC855 OR RP788 Loose Propellant
- 7475-T6 Aluminum Cartridge Case
- PA520 Electric Primer



Missions vs Hardware Requirements

Hardware Mission	Personnel	Material	Air to Air
FUZE	Standard PD or Air Burst	Standard PD or Short Stand-off	Standard PD or Near Miss w/PD
PROJECTILE	Frag ~ 3 grains Frag Vel – High As many as poss No liner	Penetrator/Liner Low Spin (Liner)	Frag > 10 grain Frag Vel – High As many as poss No liner
CASE & PROPELLANT	Velocity - low as possible	Velocity - low as possible (liner) Velocity - high as possible (pen)	Velocity - high as possible Case volume - high as possible



Fuze Technology Matrix

Initiation Tech	Pros	Cons
Time	Simple, low cost Accurate counter, Proven, well known technology Low power	Ineffective w/current propellant standard deviations. Requires commo w/ system FC No corrections for environ effects
Corrected Time	Accurate counter Minimize effects from velocity deviations Moderate power Demonstrated technology	Requires commo w/system FC Needs velocity measurement device Industry owned patents No corrections for environ effects
Turns	Very accurate above Mach 1+ 1 st order independent of velocity Moderate power Demonstrated technology	Requires commo w/system FC Needs accurate bbl exit twist info Industry owns some patents No corrections for environ effects
Hybrid Time/Turns	Accurate across engage range Best of time & turns Moderate power	Requires commo w/system FC Needs accurate bbl exit twist info Needs algorithm dev & verif No corrections for environ effects Proposed technology

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Fuze Technology Matrix

Initiation Tech	Pros	Cons
Active Prox	Velocity independent Triggers on target or miss dist sensing External commo on/off only	Emits detectable signal Small angle of fall gives large variation in range High power
Passive Prox	Velocity independent Triggers on target or miss dist sensing No external emissions No external commo needed	Must have target "emission" Ground targets not visible to fuze
Magnetic	Velocity independent Triggers on target sensing No external commo needed	Must have magnetic target
On-board Accelerometers	Measures & corrects for vel & environ effects during flight	Early development technology Power requirements unknown



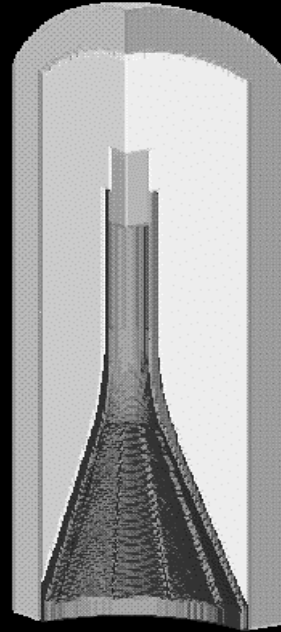
Fuze Technology Conclusions

- No One Triggering Technology Optimal for all Missions
- Combining Sensors Needed for Best Results Against Complete Target Spectrum
- Small Volume => Minimal Power Available
=> Minimum # of Sensors => Dual Use of Sensors



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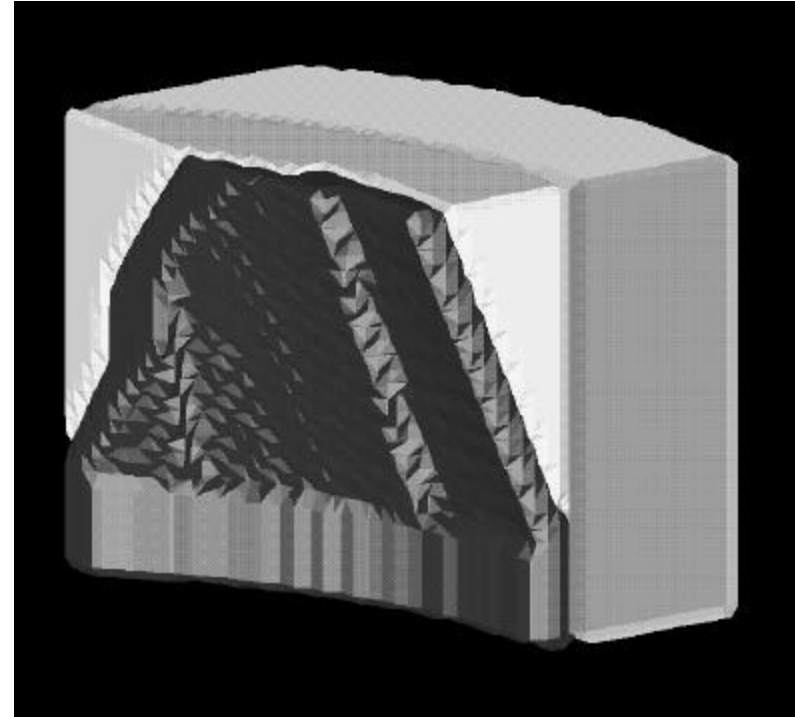
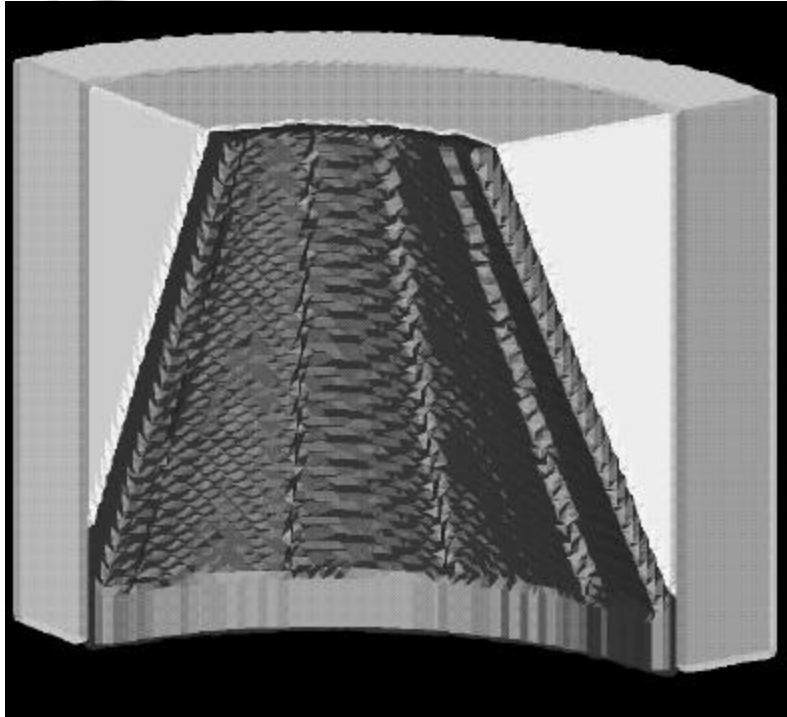


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The mesh size along the fluted region is .025 cm due to memory and CPU time limits.

The simulation required 16 CPUs from a Origin 2000 SGI supercomputer with 9 GB of RAM memory.

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Fluted Shaped Charge Design for A30mmCR

CTH Modeling

4.0 μ s



6.0 μ s



8.0 μ s



10.0 μ s



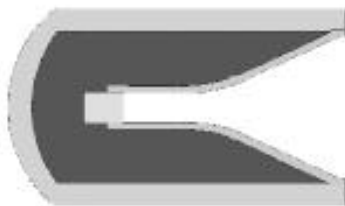
- Angular Velocity Imposed on Device
- 17 Million Cells, 16 CPUs
- 200 CPU Hours per simulation

First time that a fluted spin compensated liner has been modeled!

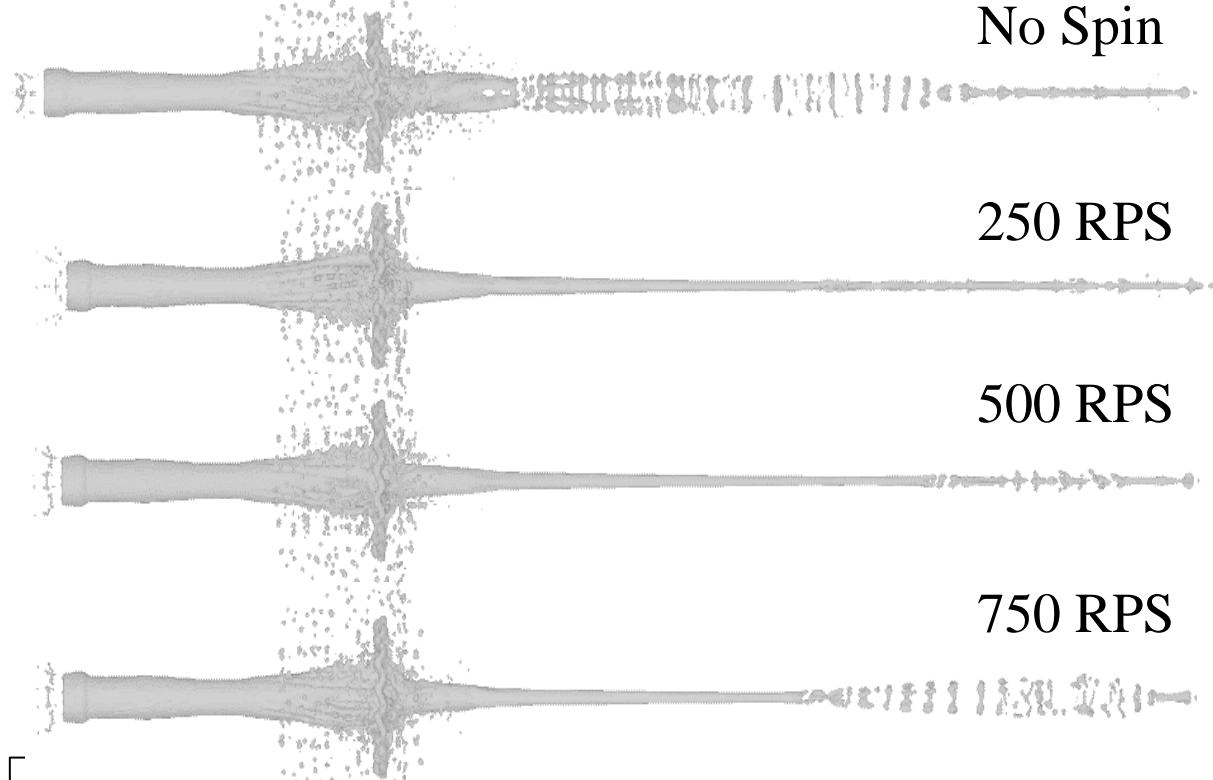


Fluted Shaped Charge Design for A30mmCR

Each run takes approximately 5 to 10 days to complete. As you will see on these two pages, the computed and actual results correlate well.



Time: 20 μ s



No Spin

250 RPS

500 RPS

750 RPS

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Fluted SC Warheads

Target Plate Results



No Spin



250 rps



500 rps



750 rps



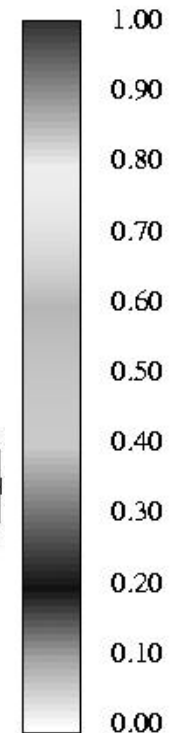
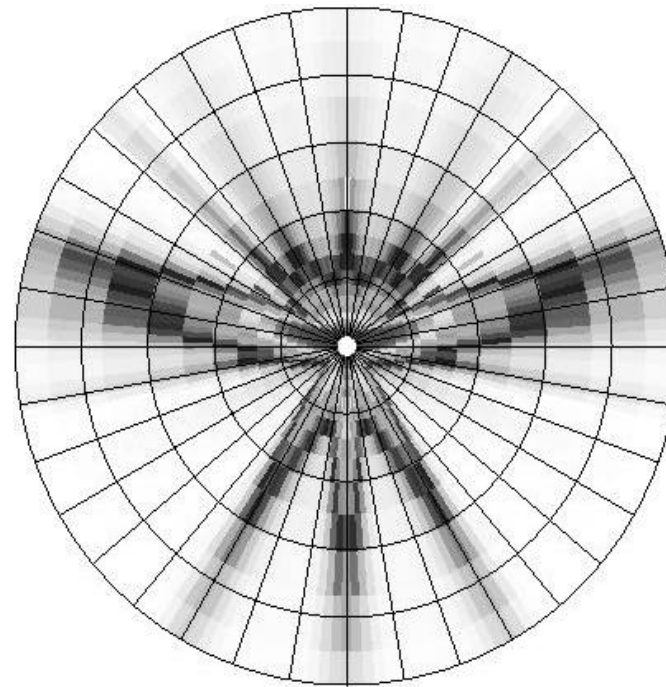
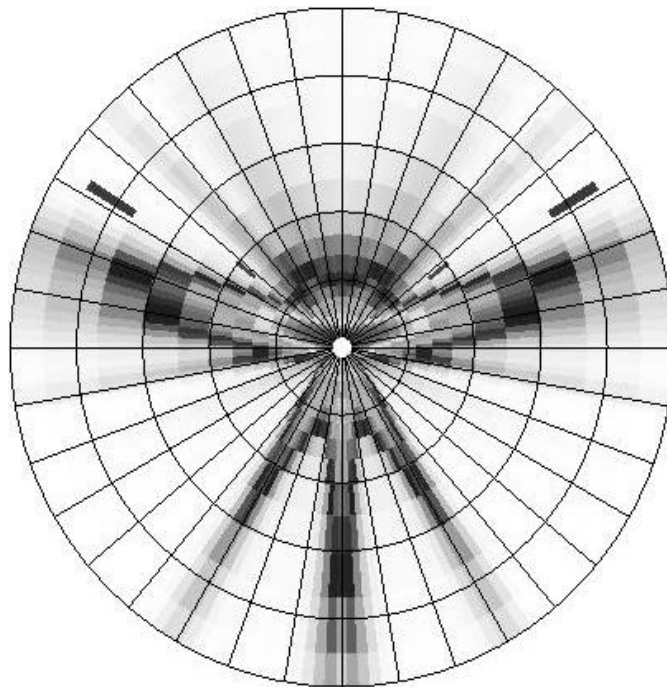
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STANDING

GROUND

AIR BURST



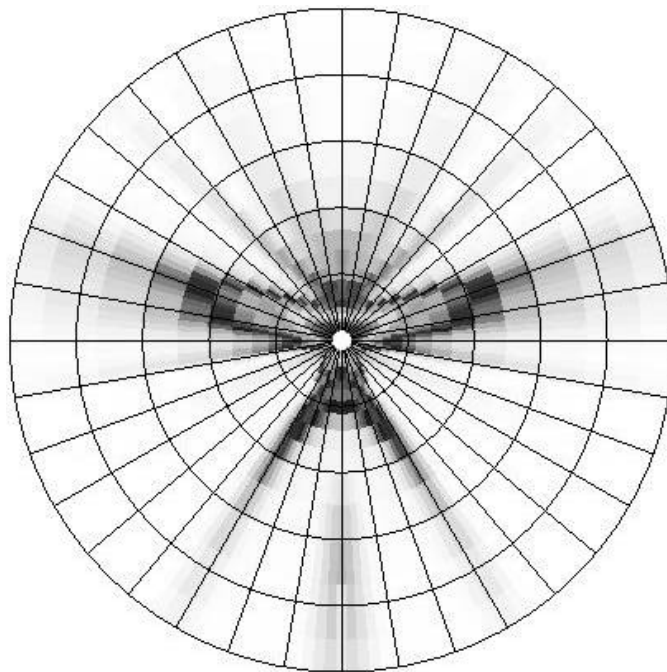


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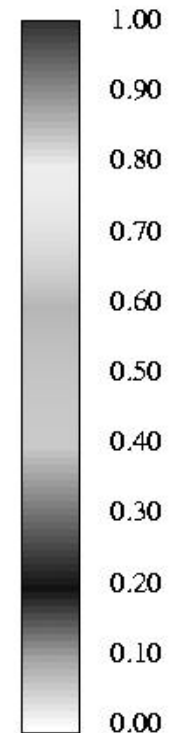
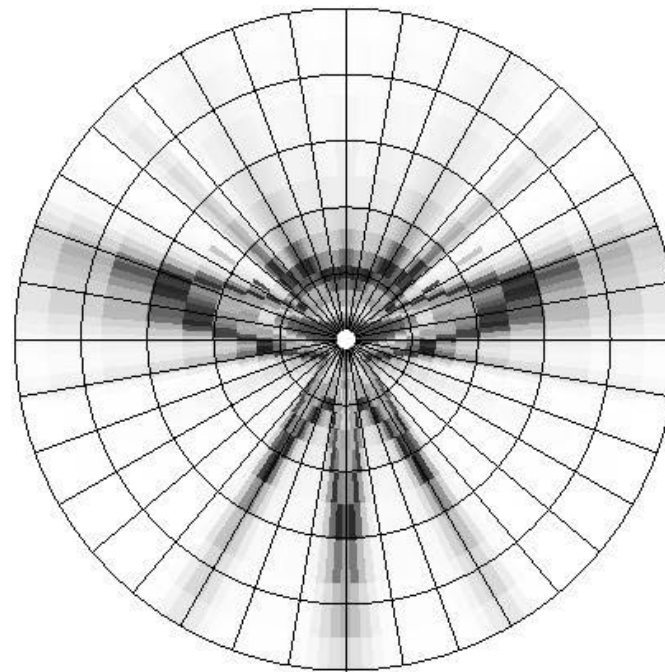
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PRONE

GROUND



AIR BURST





A30CR CONFIGURATION FOR MRAWS STUDY

- Baseline Fuze
 - Point Detonating Switch (Impact Mode)*
 - Electrostatic Sensor
 - Proximity (Anti-Air Mode)*
 - Turns Counter Sensor for Hybrid Turns/Time Solution & On-board Muzzle Velocity Correction (Air Burst Mode)
 - Inductive Message Communication w/Fire Control
 - Direct Contact Power Transfer w/On-Board Storage
- M789 Projectile, Liner, Case & Propellant
- Muzzle Velocity, Velocity Variations & Aerodynamic Effects the Same as the M789

*Default Mode of Operation for the Fuze